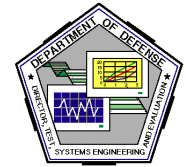


# **The Economics of Modeling and Simulation**

**Presented at the  
Summer Computer Simulation  
Conference  
Chicago, IL  
July 12, 1999**

Chicago  
5/29/99

Robin Frost  
DTSE&E/SE  
(703) 693-  
7637



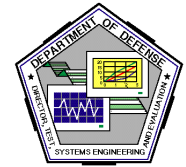
# Outline

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- The Issue -

Given the SBA initiative is meant to not only lower the O&S costs to DoD but also the total product life cycle cost, what are the DoD/Industry business model changes necessary to enable movement of these O&S dollars further forward in the life cycle and enable them to be used to increase the virtual modeling/simulation of the O&S part of the product life cycle and save money later?

- SBA Vision and Concept
- Our experience in DoD: SBA “Business Case”
- Another view on business cases: ICAF
- A practical example of virtual O&S: JSF
- Rules Governing Movement of O&S Dollars
- A new business model for the US?: UK example
- Summary



# The Issue

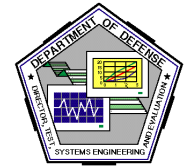
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Given the SBA initiative is meant to not only lower the O&S costs to DoD but also the total product life cycle cost, **what are the DoD/Industry business model changes necessary to:**

- enable movement of these O&S dollars further forward in the life cycle and
- enable them to be used to increase the virtual modeling/simulation of the O&S part of the product life cycle and save money later?



# SIMULATION BASED ACQUISITION (SBA)



## *Vision*

...to have an Acquisition Process in which DoD and Industry are enabled by robust, **collaborative use of simulation technology** that is **integrated across acquisition phases and programs.**

## *Goals*

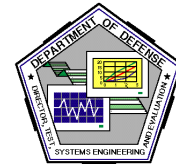
Substantially **reduce the time, resources and risk** associated with the entire acquisition process;

**Increase the quality, military worth and supportability** of fielded systems, while **reducing** their **operating and sustaining costs throughout the total life cycle;**

Enable Integrated Product and Process Development (IPPD) **across the entire acquisition life cycle.**



# SBA NOT JUST TECHNOLOGY

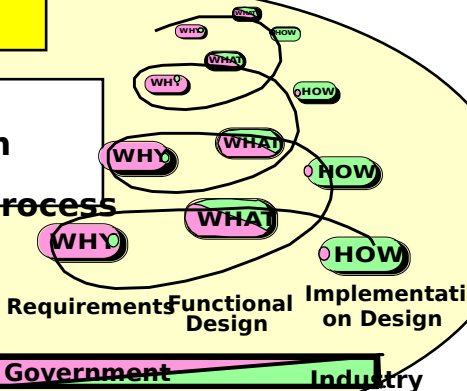


## Process

### Iterative Acquisition Process

#### • Iterative Spiral Process

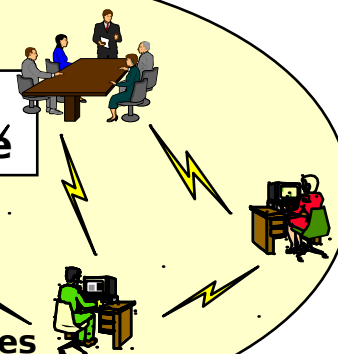
- Electronic Exchange of System Models of Multiple Options
- Rapid Evaluation



## Culture

### Evolved Acquisition Culture

- Enabled Integrated Process Teams
- Changing Roles and Responsibilities



## Environment

### Integrated Advanced Engineering and Management Enterprise

- Collaborative Distributed Engineering
- Seamless Integration of Engineering Disciplines
- User Transparent Web Style Access

Common Project Data Repository  
Integrated Product Process Model Format

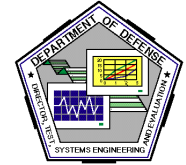
- Integrated Design Data Schema

Together, these will facilitate

***An unprecedented quality of enterprise-wide, collaborative decision making across the acquisition life-cycle...***



# TOP FOUR SBA ACTIONS TO IMPLEMENT



## -- THE VOICE OF THE CUSTOMER\* --

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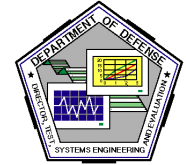
- Implement appropriate collaborative environments.
- Establish a concept of operations for use of Distributed Product Descriptions (DPDs) throughout the acquisition life cycle.
- Establish and resource a process for populating and managing an online DoD/Industry repository.
- Define, adopt, and develop relevant standard data interchange formats (DIFs) for the SBA architecture.

*\*THE CUSTOMER: Services, Industry, Agencies*

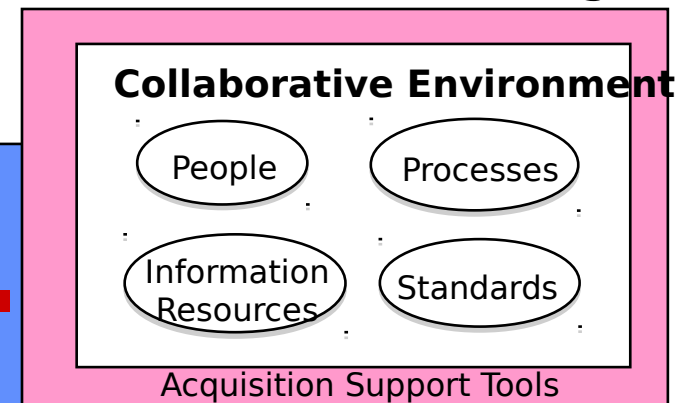
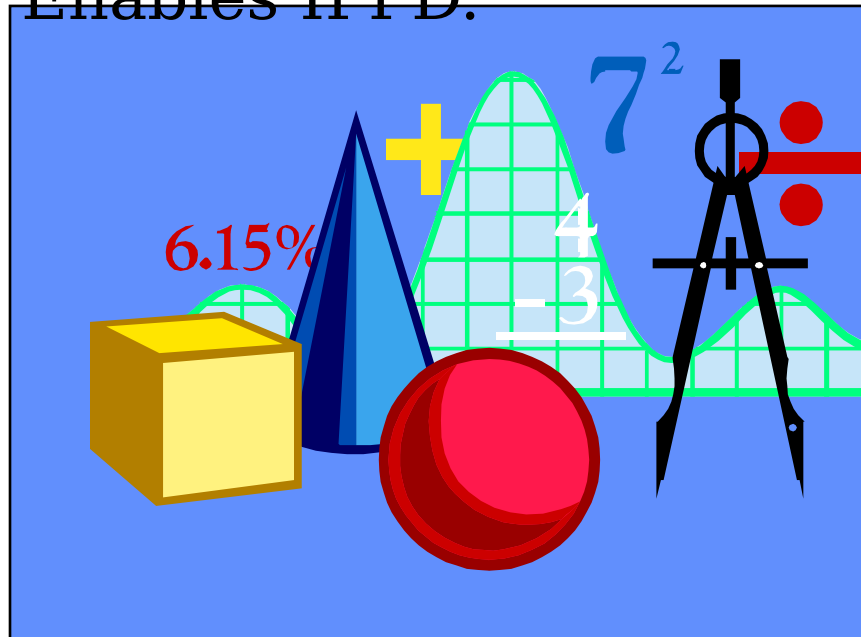


# KEY CONCEPT

## Collaborative Environments (CE)



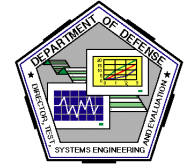
- An enduring collection of resources, people, processes, and tools assembled to attack a given problem.
- Enables IPPD.



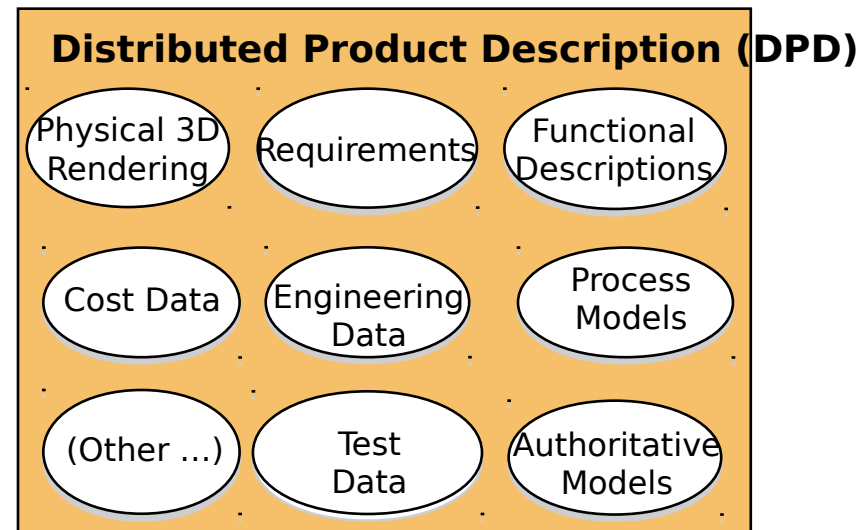


# KEY CONCEPT

## Distributed Product Description (DPD)



- In its simplest form, a 3-dimensional representation of a system, along with associated process data
  - **Functional information (what does this thing do?)**
  - **Requirements information (why do we need this?)**
  - **Manufacturing information (what special tooling do we need to produce it?)**
  - **Cost information (how much does it cost?)**
- Has other features like “user selectable views.”



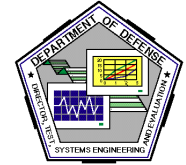




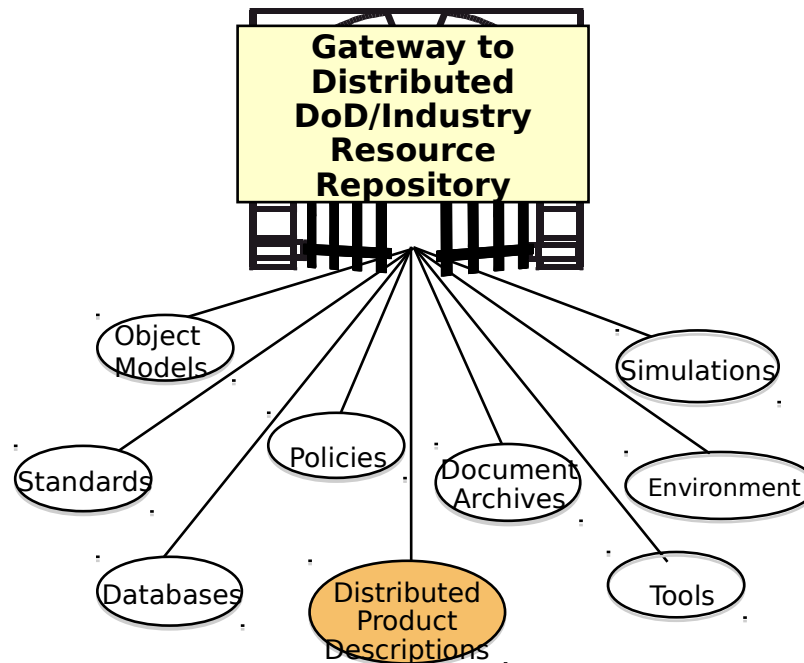
# KEY CONCEPT

## DoD/Industry Resource Repository (DIRR)

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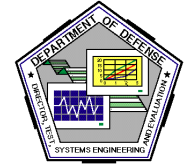


- A collection of pointers constituting a web technology-based distributed repository of tools, information resources, and generic infrastructure components for use within and reuse across acquisition programs.
- The union of capabilities provided by all Collaborative Environments.





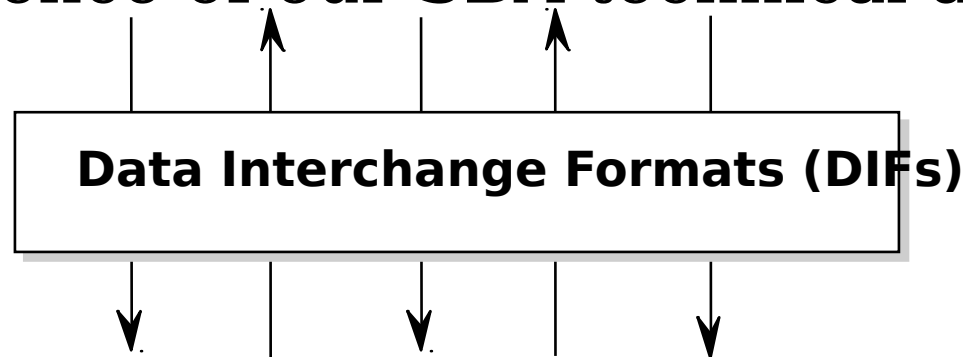
# KEY CONCEPT



## Digital Interchange Format (DIF)

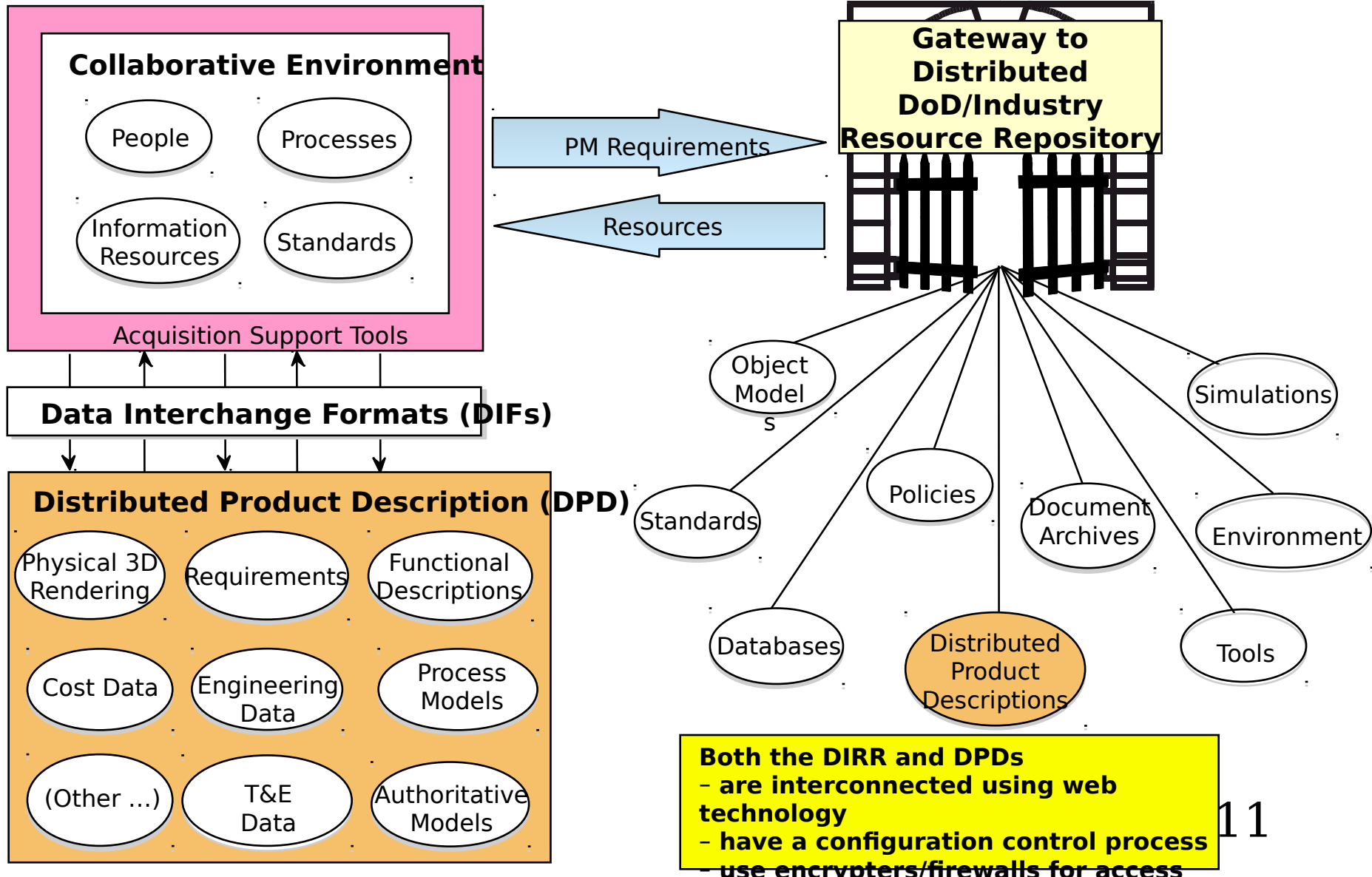
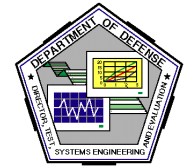
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- Will be an extension to existing DIFs where they currently exist, such as SEDRIS.
- Will be the “go between” for DPDs and the outside world (DIRR, etc).
- Will propose DIFs to DMSO Common Technical Framework/data std portion and the Joint Technical Architecture.
- The essence of our SBA technical architecture.



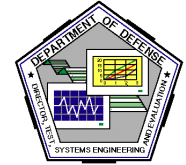


# Top-Level View of SBA Systems Architecture





# Funding Plan in Support of Simulation Based Acquisition

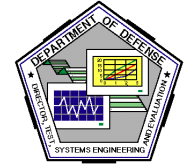


Task	Description/Notes
AD&S Group Core Technical Expertise	Assumes a full-time technical leader and six full-time-equivalent technical personnel to provide core technical expertise. Federal Advisory Committee sponsorship
Immediate Pathfinders	Total for effort in direct support of selected set of 6 immediate pathfinders. Technical development of core architecture concepts based on immediate pathfinders, done in conjunction with AD&S technical team.
Collaborative Environment (CE) Pilot Efforts	Three long-term CE pilot efforts (one per Service) over a 3 year period. One long-term mission area pilot effort over a 2 year period Technical development of core architecture concepts based on CE pilot efforts, done in conjunction with AD&S core technical team.
DoD/Industry Resource Repository (DIRR)	Assumes a small plus-up to the MSRR BoD.
Distributed Product Description (DPD) Tool Development	Development of prototype DPD access tool with basic capabilities such as user-selectable views.
SBA Science & Technology (S&T) Needs Study	Study to better define gaps between ongoing S&T and R&D activities and SBA-related needs, and to consider required investments to address already identified technical challenges.
SBA Business Game Series	Requirements determination seminars.
Technical Support to DoD PSA	4 FTE's per year



# SBA Business Case -The DoD Experience-

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**Premise:** SBA can reduce total ownership costs, shorten cycle time, and improve the quality of the final product.

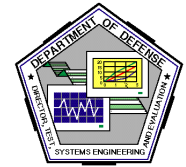
## **Challenges:**

- Time: Cut acquisition cycle time by 50%
- Cost: Reduce Total Ownership Costs (TOC). Typically 60% of the TOC of any platform is tied to Operations and Maintenance (O&M).
- Quality: Improve the quality of systems by incorporating today's ever more complex technologies (without increasing the acquisition cost proportionally)



# SBA Business Case -The DoD Experience- (cont.)

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**Evidence:** Can be found in every aspect of acquisition (analysis, design and engineering, production and manufacturing, test and evaluation, and logistics and sustainment).

- **Design/Engineering**

- TARDEC design of a low silhouette tank prototype
  - 168 man-years (projected) using traditional methods

*versus*

  - 19 man-years using new M&S tools
- In the DARPA Initiative for Concurrent Engineering program, TRW redesigned a radar warning system using (1) traditional and (2) concurrent design with integrated design automation methods.
  - 8 man-years using traditional methods

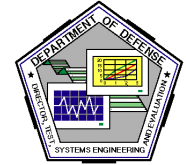
*versus*

  - 4.5 man-years using advanced methods
- General Electric used a new parametric modeling approach to design a new engine fan blade
  - reduced the process time from approx. 4 weeks to a few hours.



# SBA Business Case -The DoD Experience- (cont.)

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## Evidence (cont.):

- **Sustainment/Logistics**

- Submarine Standard parts list
  - 95,000 for the Seawolf class
  - 16,000 for the NSSN by using new M&S tools

- **Testing**

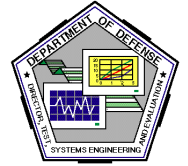
- Attack helicopter source selection
  - \$500 million for the prototype aircraft fly-off for the UH-60 Blackhawk
  - \$20 million for the Comanche using the Simulator Surrogate Aircraft Fly-Off
- Navy in-water torpedo testing
  - \$50k to \$80k per firing using traditional techniques
  - 100 to 300 tests can be run for the same price by using simulation



# Core Issue #9

## Building a Business Case for SBA

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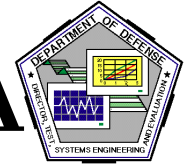


- Needs to compete against real programs.
- Needs to demonstrate an ROI.
- Needs to be compared to a baseline
- Do we rely on anecdotal data?
- What is a “real” business case? What is the product?
- No ROI analysis will hold up. A real business case is more than an ROI.
- Having to build a business case will take time & resources.
- How do you put a number on integration of such things as processes? Metrics approach has proven artificial at best in past cases. (assignment of the TOC and Cycle Time Reduction contribution by individual initiatives is artificial)





## Core Issue #9



# Building a Business Case for SBA (cont.)

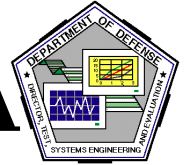
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- **Strategic investment plan** instead of a business case: identify critical shortfalls
- Build a business model over time with option to exit if initiative doesn't appear to be successful
- Deal individually with people who require a business case to convince them they really don't need one
- Use pilot program results documented as business case
- Move forward without a business case...it's going to happen anyway



## Core Issue #9

# Building a Business Case for SBA



**(cont.)**

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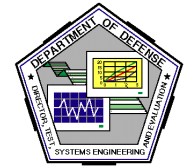
### Summary:

- Avoid a Return on Investment approach
- Carryout business games to shed light and develop better insight into SBA
- Use pathfinders and pilot results as evidence to move forward without a business case



# ACQ POLICY II RESEARCH PAPER: “BUILDING A BUSINESS CASE FOR M&S”, ICAF

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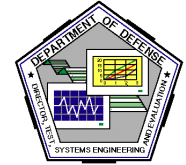
## Results of surveys:

- “PMs are investing in M&S to support program development, however, most of the investment decisions were based on intuition or need-based factors. Most decisions were made without detailed quantitative analysis.”
- “The reasoning for this investment was a ‘gut-feel’ or was generated by an interest in M&S.”
- “Most PMs justified their M&S investment based on one or more of the following:
  - A. Reducing design cycle time
  - B. Augmenting or replacing physical tests
  - C. Helping resolve limitations of funds, assets, or schedules; or
  - D. Providing insight into issues that were impossible or impractical to examine in other ways”
- “Much of the feedback reflected that PMs has tried to examine costs and measure them against benefits – but without the help of any business case analysis format.”



# ACQ POLICY II RESEARCH PAPER: “BUILDING A BUSINESS CASE FOR M&S”, ICAF (cont.)

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## Results of surveys (cont.):

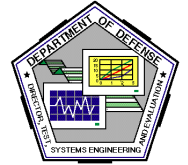
- “The majority of respondents suggested the question of using M&S was not one of ‘should I’ but rather, ‘how can I?’ This demonstrates general acceptance that M&S is required in an efficiently managed program.”
- “Considering that much of the benefit of M&S investment is intangible, traditional measurement approaches may not provide an accurate assessment.”
- Existing DoD investment guidance is provided by
  - DoD Instruction (DODI) #704.3, *Economic Analysis for Decisionmaking*, Nov. 95. Enclosure 3 of the DODI, *Procedures for Economic Analysis*, provides an insightful overview of methodology, criteria, and a discussion of sensitivity analysis.
  - The General Services Administration’s *Information Technology Capital Planning and Investment Guide*, Jan. 98, also provides procedures for economic analysis. Services may have supplemental guidance.
- “Many PMs dismiss the concept of non-quantifiable benefits.”
- “External benefits are those which do not bring direct return or savings to the unique program being managed, but have applicability beyond the PM’s purse.”



# A Practical Example:

# JSF

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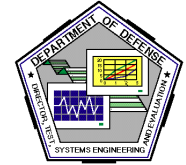


- F-16 O&S Costs = 78% of life-cycle costs.
- IPPD: Focus in on R&M During Design (R&D Money)
  - Example: LO System Supportability
- Policies that Constrain Revolutionary Support Concepts:
  - Color of Money (Tomahawk Example)

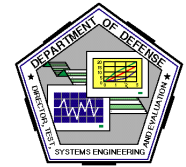


# Movement of O&M Money to RDT&E

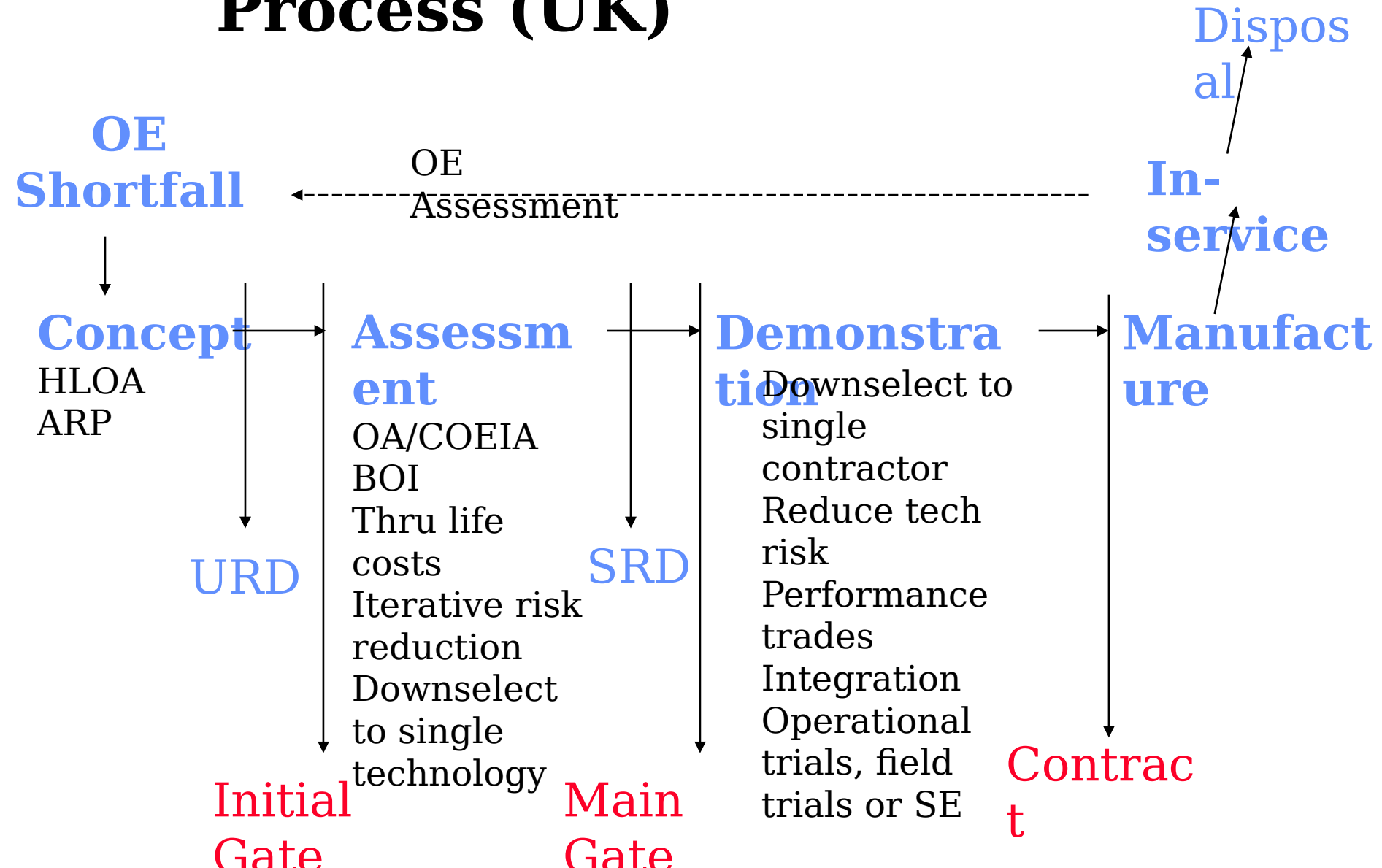
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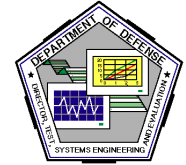


- **The Misappropriation Act:** Title 31, U.S. Code, Section 1301, requires that funds be used only for the programs and purposes for which the appropriation is made. This, along with the stated purpose on a given funding document, is the basis for propriety of funds determinations by the Comptroller.



# The New Procurement Process (UK)





# Summary

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- A business case is difficult even with quantifiable benefits (e.g., baselines, previous cases to draw upon, etc.)
- SBA is inevitable and DoD is moving forward (but will it be one SBA or multiple SBAs? Need corporate approach)
- There are appropriations restrictions to movement of O&M dollars to the R&D phase, and this serves to inhibit implementation of SBA concepts/virtual O&M
- Where do we go from here?
  - Fund the corporate approach (small core) without requiring a business case
  - encourage continued collection of benefits (quantifiable & unquantifiable) by PMS, ICAF, etc. to help the cause